UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/035,027	12/28/2001	Xiangyang Zhuang	CR00311M(72463)	9194

22242 7590 11/15/2007

FITCH EVEN TABIN AND FLANNERY
120 SOUTH LA SALLE STREET
SUITE 1600
CHICAGO, IL 60603-3406

EXAMINER	
HO, CHUONG T	

ART UNIT	PAPER NUMBER
2619	

MAIL DATE	DELIVERY MODE
11/15/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/035,027	ZHUANG ET AL.	
	Examiner	Art Unit	
	CHUONG T. HO	2619	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 January 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,10-19,22,23,28 and 29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *19,22,23,28 and 29* is/are allowed.

6)☒ Claim(s) *1-8,10-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. The appeal brief filed 01/23/07 have been entered and made of record.

2. In view of the appeal brief filed on 01/23/07, PROSECUTION IS HEREBY REOPENED. The new office action set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:

3. Applicant's arguments with respect to claims 1, 12, 17 have been considered but are moot in view of the new ground(s) of rejection.

4. Claims 1-8, 10-11, 12-16, 17, 18, 19, 22, 23, 28, 29 are pending.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims, 1, 12, 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (U.S.Patent No. 6,771,706 B2) in view of Vila et al. (U.S.Patent No. 6,757,348).

In the claim 1, Ling et al. discloses providing a datastream comprised of bits (see figure 2A, col. 6, lines 38-52, encoder 202 receives and encodes the information bits in accordance with a particular encoding scheme to provide coded bits); comprising:

- Interleaving (see figure 2A, col. 6, lines 42-43, channel interleaver 204) the bits of the datastream across a plurality of orthogonal frequency division multiplexing radio frequency transmitters (modulator 122a, modulator 122t) (see fig.2A, col. 7, lines 58 - 61, a demultiplexer 214 demultiplexes the received modulation symbols into a number (N (T)) streams of modulation symbols, one stream for each antenna used to transmit the modulation symbols. Each stream of modulation symbols is provided to a respective modulator 122), wherein each of the radio frequency transmitters (fig. 2A, 122a, 122T) transmits a plurality of radio frequency subcarriers to provide interleaved bits (see col. 7, lines 63-66, each modulator 122 converts the modulation symbols into an analog

signal, and further amplifies, filters, quadrature modulates, and upconverts the signal to generate a modulated signal suitable for transmission over the wireless link);

- Transmitting data that corresponds to the interleaved bits using the plurality of radio frequency subscarriers of the plurality of orthogonal frequency division multiplexed radio frequency transmitters (122a..122t) (see col. 7, lines 63-66, each modulator 122 converts the modulation symbols into an analog signal, and further amplifies, filters, quadrature modulates, and upconverts the signal to generate a modulated signal suitable for transmission over the wireless link).

However, Ling is silent to disclosing wherein adjacent bits are assigned to different transmitters and different subcarriers.

Vila et al. discloses wherein adjacent bits (col. 4, lines 27-28, data symbols is use here in a generic sense and my comprise bits) (figure 3, data symbols 0, 1, 2, 3, 4, 5, 6, 7 are assigned communication links 34a, 34b, 34c, 34d, col. 4, lines 34-35, lines 8-13, lines 38-45) (col. 4, lines 26-27, datastream includes 32 data symbols) are assigned to different transmitters (figure 3, communication links 34a, 34b, 34c, 34d) and different subcarriers (see abstract, transmission lanes).

Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate wherein adjacent bits are assigned to different transmitters and different subcarriers taught by Vila into the system of Ling. One would have been

motivated to do so to multiplex from a single serial stream to a serial stream for each of the lane.

6. In the claim 12, see figure 1, Ling et al. discloses an encoder (fig.2A, encoder 202) having a single datastream input and an encoded bits datastream output (see fig.2a, col. 6, lines 38-39); comprising:

- A multiple-input multiple-output modulator (figure 2A, DEMUX 214) having an input operably coupled to the encoded bits datastream output of the encoder (fig.2A, encoder 202) and having a serial-to-parallel output that provides first (fig. 2A, MOD 122a) and second (fig.2A, MOD 122t) items of modulation information that corresponding to the encoded bits (see col. 7, lines 58-67);
- A first orthogonal frequency division multiplexed transmitter (fig.2A, MOD 122a) having an input operably coupled to a first output of the serial-to-parallel output of the multiple-input multiple-output modulator (fig.2A, DEMUX 214) to receive the first items of modulation information (see col. 7, lines 58-67);
- A second orthogonal frequency division multiplexed transmitter (fig.2A, 122t) having: an input operably coupled to a second output of the serial-to-parallel output of the multiple-input multiple-output modulator (fig.2A, DEMUX 214) to receive the second items of modulation information (see col. 7, lines 58-67); and a multiple subcarrier radio frequency transmission output (fig.2A, 124a..124t, col. 7, lines 58-67);

- Such that information comprising the encoded bits datastream (see col. 7, lines 42-44, channel interleaver 204) are interleaved across the multiple subcarriers of the first (fig.2A, 122a) and second (fig.2A, 122t) orthogonal frequency division multiplexed transmitters (see col. 7, lines 58-67) (fig. 2A, MOD 122a, 122t) (fig.2A, 124a,..., 124t) (see figure 4, figure 2A, col. 10, lines 61-67, demultiplexer 408 demultiplexes the input data into a number of (K) channel data stream B(1) through B (K) "different channel data stream for each transmitters". Each channel data stream may correspond to a signaling channel, a broadcast channel, a voice call, or a packet data transmission) (see col. 6, lines 46-49, symbol mapping element 208 maps the unpuntured coded bit into modulation symbols for one or more transmission channels used for transmitting the data).

However, Ling is silent to disclosing wherein adjacent bits are assigned to different transmitters and different subcarriers.

Vila et al. discloses wherein adjacent bits (figure 3, bits 0, 1, 2, 3, 4, 5, 6, 7 are assigned communication links 34a, 34b, 34c, 34d, col. 4, lines 34-35, lines 8-13, lines 38-45) are assigned to different transmitters (figure 3, communication links 34a, 34b, 34c, 34d) and different subcarriers (see abstract, transmission lanes).

Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate wherein adjacent bits are assigned to different transmitters and different subcarriers taught by Vila into the system of Ling. One would have been

motivated to do so to multiplex from a single serial stream to a serial stream for each of the lane.

7. In the claim 17, Ling et al. discloses providing a first (fig.2A, 122a) and second (fig.2A, 122t) orthogonal frequency division multiplexed transmitter wherein each transmitter transmits a plurality of subcarriers (see col. 7, lines 58-67) at frequencies that are substantially identical as between the first (fig.2A, 122a) and second (fig.2A, 122t);

Providing a single stream of data comprised of sequential bits (see fig.2A, col. 6, lines 30-33);

Interleaving (fig.2A, see col. 6, lines 42-44, interleaver 204) the sequential bits across the plurality of subcarriers (see fig.2A, col. 7, lines 58-67) for both the first (fig.2A, 122a) and second (fig.2A, 122t) orthogonal frequency division multiplexed transmitters (see col. 7, lines 58-67) (fig.2A, 122a...122t) (see figure 4, figure 2A, col. 10, lines 61-67, demultiplexer 408 demultiplexes the input data into a number of (K) channel data stream B(1) through B (K) "different channel data stream for each transmitters". Each channel data stream may correspond to a signaling channel, a broadcast channel, a voice call, or a packet data transmission) (see col. 6, lines 46-49, symbol mapping element 208 maps the unpuntured coded bit into modulation symbols for one or more transmission channels used for transmitting the data).

However, Ling is silent to disclosing wherein adjacent bits are assigned to different transmitters and different subcarriers.

Vila et al. discloses wherein adjacent bits (figure 3, bits 0, 1, 2, 3, 4, 5, 6, 7 are assigned communication links 34a, 34b, 34c, 34d, col. 4, lines 34-35, lines 8-13, lines 38-45) are assigned to different transmitters (figure 3, communication links 34a, 34b, 34c, 34d) and different subcarriers (see abstract, transmission lanes).

Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate wherein adjacent bits are assigned to different transmitters and different subcarriers taught by Vila into the system of Ling. One would have been motivated to do so to multiplex from a single serial stream to a serial stream for each of the lane.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 2-8, 10-11, 13-16, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combined system (Ling - Vila) in view of Sarraf et al. (U.S.Patent No. 6,747,948 B1).

In the claim 2, Ling et al. discloses the limitations of claim 1 above.

However, Ling et al. is silent to disclosing providing datastream comprised of bits includes providing a datastream comprised of bits as provided from a single source.

Sarraf et al. , see figure 2, discloses the signal generation unit modulates a plurality of subcarriers, which may be OFDM sub-carriers, based on the interleaved substream and upconverts the modulated subcarriers for transmission (see col. 2, lines 32-35); comprising:

- providing datastream comprised of bits includes providing a datastream comprised of bits as provided from a single source (see col. 2, lines 20-22, the encoder receives blocks of source data from one or more data sources).

Both Ling, Vila and Sarraf discloses an orthogonal frequency division multiplexing (OFDM). Sarraf recognizes providing datastream comprised of bits includes providing a datastream comprised of bits as provided from a single source. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined system (Ling - Vila) with the teaching of Sarraf to provide providing datastream comprised of bits includes providing a datastream comprised of bits as provided from a single source in order to improve the performance of error correction decoders.

10. In the claim 3, Sarraf et al. discloses provising a datastream comprised of bits includes providing a datastream comprised of bits as provided from a plurality of sources (see col. 2, lines 20-22, the encoder receives blocks of source data from one or more data sources).

11. In the claim 4, Sarraf et al. discloses providing a datastream comprised of bits as provided from a plurality of sources (see col. 2, lines 20-22, the encoder receives blocks of source data from one or more data sources) includes providing a datastream

comprised of bits as provided from a plurality of sources (see col. 2, lines 20-22, the encoder receives blocks of source data from one or more data sources) wherein at least some of the bits as provided from at least one of the plurality of sources are encoded bits (encoding unit 16, see figure 2) (see col. 3, lines 27-55).

12. In the claim 5, Sarraf et al. discloses providing a datastream comprised of bits includes providing a datastream comprised of encoded bits (encoded data, see abstract) (see col. 3, lines 27-55).

13. In the claims 6, 13, 14, 15, Sarraf et al. discloses a datastream comprised of encoded bit includes providing a datastream comprised of convolutionally encoded bits (see col. 3, lines 27-55).

14. In the claim 7, Sarraf et al. discloses providing a datastream comprised of encoded bits includes providing a datastream comprised of serially concatenated convolutionally encoded bits (see col. 3, lines 27-55).

15. In the claim 8, Sarraf et al. discloses providing a datastream comprised of encoded bits includes providing a datastream comprised of parallel (see col. 3, line 21) concatenated convolutionally encoded bits (see col. 3, lines 27-55).

16. In the claim 9, See figure 1, Ling et al. discloses providing a datastream (see col.4, lines 25-27) comprising of encoded bits includes providing a datastream comprised of encoded bits (FEC Encoder 102) (see col. 4, lines 30-35); and interleaving (interleaver 103) the bits of the datastream across a plurality of orthogonal frequency division multiplexed radio frequency transmitters (106, 116, 126) includes interleaving

the encoded bits of the datastream across the plurality of orthogonal frequency division multiplexed radio frequency transmitters (106, 116, 126) (see col. 4, lines 37-49).

17. In the claim 10, Sarraf et al. discloses interleaving the encoded bits of the datastream includes alternating assignment of consecutive encoded bits to the radio frequency transmitters and on a plurality of the subcarriers having channel responses with low correlation (see col. 3, lines 57-67, col. 4, lines 1-5).

18. In the claims 11, 16, Sarraf et al. discloses transmitting data that corresponds to the interleaved bits includes transmitting symbols wherein each symbol represents a plurality of the interleaved bits (see col. 3, lines 57-67).

19. In the claim 18, Ling et al. discloses interleaving (see figure 1, interleaver 103) the sequential the sequential bits across the plurality of subcarriers of both the first (106) and second (116) orthogonal frequency division multiplexed transmitters includes interleaving the sequential bits across the plurality of subcarriers (see col. 4, lines 37-49) for both the first (106) and second (116) orthogonal frequency division multiplexed transmitters such that consecutive encoded bits of each datastream will be transmitted from transmitters and subcarriers with substantially minimal correlation (see col. 6, lines 66-67).

Allowable Subject Matter

20. Claims 19, 22, 23, 28-29 are allowed.

21. The following is an examiner's statement of reasons for allowance: the prior art (6771706, 6747948, 6850481, 20030072254, 20020122381, 20030003880, 6771706, 20020191703) of record does not appear to teach or render obvious the claimed

limitations in combination with the specific added limitations, as recited from independent claim 28: "wherein demodulation include the use of a zero forcing symbol metric estimator based on ('In" stands for the natural logarithm) In P (...) where S is the estimated symbol at the Kth subcarrier of the Jth transmitted antenna, i.e. [..] = w, yk with filter matrix Wk being the zero forcing matrix computed based on the channel matrix Hk and where Wk (:j) denoted the jth column of Wk "II.II" denotes the vector nome, O is the noise power, and S is any of the constellation symbols ".

22. The following is an examiner's statement of reasons for allowance: the prior art (6771706, 6747948, 6850481, 20030072254, 20020122381, 20030003880, 6771706, 20020191703) of record does not appear to teach or render obvious the claimed limitations in combination with the specific added limitations, as recited from independent claim 29: "wherein demodulation include the use of a minimum mean squared error symbol metric estimate based on ("In" stands for the natural logarithm....is the average symbol power, and S is any of the constellation symbols".

23. The following is an examiner's statement of reasons for allowance: the prior art (6771706, 6747948, 6850481, 20030072254, 20020122381, 20030003880, 6771706, 20020191703) of record does not appear to teach or render obvious the claimed limitations in combination with the specific added limitations, as recited from independent claim 19: "demodulating the received multi-antenna transmission signals to data bits from bit metrics computed by using a maximum likelihood bit soft information estimator represented by

P (Y (k) | B (I, k)) = Sum seSi (P (Y(k) | S (k) = S) P (S (k) = S)

Where P (Y (k) | B (I, k)) is a probability of observing received signals Y (k) at the Kth subscarriers on at least one antenna under the condition of transmitting bit B (I,k) (0 or 1), and S (i) a set of all symbol vectors whose bit representations contain the given value of the bit of interest B (I, k).

24. The following is an examiner's statement of reasons for allowance: the prior art (6771706, 6747948, 6850481, 20030072254, 20020122381, 20030003880, 6771706, 20020191703) of record does not appear to teach or render obvious the claimed limitations in combination with the specific added limitations, as recited from independent claim 22: "demodulating the received multi-antenna transmission signals to recover data bits from bit metrics computed by using a zero forcing bit metric estimator represented by

P (s (j, k) | B (I, k) = Sum s, e, S (i) = exp | - | S (j, k) – S (o) | (exp 2) / (2 || W (k) (:, j) ||

.....and S (i) is a set of constellation symbols whose bit representations contain the given value of the bit of interest B (I, k).

25. The following is an examiner's statement of reasons for allowance: the prior art (6771706, 6747948, 6850481, 20030072254, 20020122381, 20030003880, 6771706, 20020191703) of record does not appear to teach or render obvious the claimed limitations in combination with the specific added limitations, as recited from independent claim 23: "demodulating the received multi-antenna transmission signals to recover data bits from bit metrics computed by using a minimum mean squared error bit metric estimator represented by.....and S (i) is a set of constellation symbols whose bit representations contain the given value of the bit of interest b (I, k).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHUONG T. HO whose telephone number is (571) 272-3133. The examiner can normally be reached on 8:00 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ORGAD EDAN can be reached on (571) 272-7884. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

11/06/07

EDAN . ORGAD
SUPERVISORY PATENT EXAMINER